PATTERN FORMATION METHOD AND PHOTORESIST MATERIAL FOR IT

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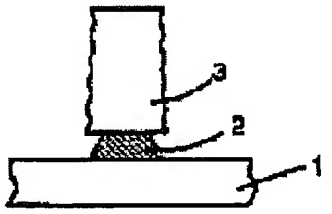
Abstract of **JP8286384**

PURPOSE: To provide a pattern formation method by which a pattern is formed at one exposure and development, and a radiation sensitive composition used for it by reducing dimensional fluctuation and deformation of a pattern caused by interference action and irregular reflection due to reflection light from a substrate in the case of forming a fine pattern by lithography technology. CONSTITUTION: After the second photoresist film 3 whose absorbency in an exposure wavelength is smaller and sensitivity is lower than the first photoresist film is formed on the first photoresist film 2, an exposure development is performed. Largeness of the absorbency of the first resist film 2 reduces the reflection light from the substrate 1 and the sensitivity of the first resist film 2 is higher than that of the resist film 3 so that the pattern size of the first photoresist 2 can be reduced to less than the pattern size of the second photoresist 2 so that the dimensional fluctuation and deformation of the pattern can be reduced.



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CLAIMS

[Claim(s)]
[Claim 1] By heat-treatment after the process which forms the 1st photoresist film on a substrate, the process which forms the 2nd photoresist film on said 1st photoresist film, pattern exposure or pattern exposure, and exposure In the pattern formation approach including the process which forms a latent image in said 1st and 2nd photoresist film, and the process which develops said 1st and 2nd photoresist film with the same developer after latent-image formation The pattern formation approach characterized by the absorbance in said exposure wavelength of said 1st photoresist being larger than the absorbance of said 2nd photoresist film, and the pattern dimension of said 1st photoresist after said development becoming below the pattern dimension of said 2nd photoresist.
[Claim 2] The pattern formation approach characterized by for the absorbance in the above-mentioned exposure wavelength of the photoresist film of the above 1st being in the range per [2-6] micrometer, and the absorbance of the photoresist film of the above 2nd being in the range per [0.1-0.8] micrometer in the pattern formation approach according to claim 1.
[Claim 3] The pattern formation approach that thickness of the photoresist film of the above 1st is characterized by being smaller than the thickness of the photoresist film of the above 2nd in the pattern formation approach according to claim 1 or 2.
[Claim 4] The pattern formation approach that thickness of the photoresist film of the above 1st is characterized by being in the range of 0.05 to 0.5 micrometers in the pattern formation approach according to claim 1 to 3.
[Claim 5] The pattern formation approach that sensibility of the 1st photoresist of the above in the above-mentioned exposure wavelength is characterized by being higher than the sensibility of the 2nd photoresist of the above in the pattern formation approach according to claim 1 to 4.
[Claim 6] The pattern formation approach that sensibility of the 1st photoresist of the above in the above-mentioned exposure wavelength is characterized by being higher than the sensibility of the 2nd photoresist of the above in the pattern formation approach according to claim 1 to 5.
[Claim 7] The pattern formation approach characterized by the 1st and 2nd photoresists of the above containing at least the alkali fusibility high molecular compound and quinone diazide compound which have a ring in the pattern formation approach according to claim 1 to 6.
[Claim 8] The pattern formation approach characterized by being the photoresist of the positive type with which alkali fusibility increases by heat-treatment after the above-mentioned pattern exposure or the above-mentioned pattern exposure, and exposure, including at least the high molecular compound with which the 1st and 2nd photoresists of the above have the compound and ring which generate an acid in exposure in the pattern formation approach according to claim 1 to 6.
[Claim 9] The pattern formation approach that the 1st photoresist of the above is characterized by including poly dimethyl glutar imide and a quinone diazide compound at least in the pattern formation approach according to claim 1 to 6.
[Claim 10] The pattern formation approach that said high molecular compound is characterized at least by being the copolymer of a monomer chosen from the group which consists of the carboxylic acid of

the monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination, or a methacrylate system, a carboxylic acid of an acrylate system, and its combination in the pattern formation approach according to claim 1 to 6 by the 1st photoresist of the above including a high molecular compound.

[Claim 11] The pattern formation approach that the 1st photoresist of the above is characterized by including a quinone diazide compound in the pattern formation approach according to claim 10.

[Claim 12] In the pattern formation approach according to claim 1 to 6 the 1st photoresist of the above The compound and high molecular compound which generate an acid in exposure are included at least. Said high molecular compound at least The monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination, The monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination, the [or / tertiary butyl methacrylate and] -- the pattern formation approach characterized by being the copolymer of a monomer chosen from the group which consists of 3-butyl acrylate and its combination.

[Claim 13] The pattern formation approach characterized by being the copolymer which contains the monomer chosen from the group which molar extinction coefficient epsilon in the above-mentioned exposure wavelength becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in addition to the monomer of the above [the above-mentioned high molecular compound] in the pattern formation approach according to claim 10 to 12.

[Claim 14] The pattern formation approach that molar extinction coefficient epsilon [in /, in the 1st photoresist of the above / the above-mentioned exposure wavelength] is characterized by including the extinction agent more than 8,000 (l/cm-mol) in the pattern formation approach according to claim 9 to 13.

[Claim 15] The pattern formation approach characterized by the above-mentioned extinction agent containing a phenolic hydroxyl group in the pattern formation approach according to claim 14.

[Claim 16] The pattern formation approach characterized by the 2nd photoresist of the above containing at least the alkali fusibility high molecular compound which has a phenolic hydroxyl group in the pattern formation approach according to claim 9 to 15.

[Claim 17] The pattern formation approach characterized by the 2nd photoresist of the above containing at least the alkali fusibility high molecular compound and quinone diazide compound which have a ring in the pattern formation approach according to claim 9 to 15.

[Claim 18] The pattern formation approach characterized by being the photoresist of the positive type with which alkali fusibility increases by heat-treatment after the above-mentioned pattern exposure or the above-mentioned pattern exposure, and exposure, including at least the high molecular compound with which the 2nd photoresist of the above has the compound and ring which generate an acid in exposure in the pattern formation approach according to claim 9 to 15.

[Claim 19] The photoresist ingredient which is characterized by the absorbance of the paint film of said ingredient in 365nm being in the range per [2-6] micrometer with the ingredient with which poly dimethyl glutar imide, a quinone diazide compound, and molar extinction coefficient epsilon in 365nm contain the extinction agent more than 8,000 (l/cm-mol) at least and which carries out acid-resisting ******.

[Claim 20] a quinone diazide compound and molar extinction coefficient epsilon in 365nm -- the extinction agent more than 8,000 (l/cm-mol) -- and at least The 1st monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination, With or the ingredient included at least, the high molecular compound which is the copolymer of the 2nd monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination The photoresist ingredient which is characterized by the absorbance of the paint film of said ingredient in 365nm being in the range per [2-6] micrometer and which carries out acid-resisting ******.

[Claim 21] The photoresist ingredient with which molar extinction coefficient epsilon in the above-mentioned 365nm is characterized by copolymerizing the 3rd monomer by which the above-mentioned

high molecular compound is chosen instead of the extinction agent more than 8,000 (l/cm-mol) from the group which molar extinction coefficient epsilon in 365nm becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in addition to the above 1st or the 2nd monomer in a photoresist ingredient according to claim 20 and which carries out acid-resisting ******.
[Claim 22] The photoresist ingredient which is characterized by being the copolymer of the 3rd monomer with which it is chosen out of the group which molar extinction coefficient epsilon [in / in the above-mentioned high molecular compound / the 1st or 2nd monomer of the above and 365nm] becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in a photoresist ingredient according to claim 20 and which carries out acid-resisting ******.
[Claim 23] The compound which generates an acid by exposure, and molar extinction coefficient epsilon in 365nm The 1st monomer chosen from the extinction agent more than 8,000 (l./cm and mol), and the group which consists of alkyl methacrylate, alkyl acrylate, and its combination at least, The 2nd monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination, the [or / tertiary butyl methacrylate and] -- the high molecular compound which is the copolymer of the 3rd monomer chosen from the group which consists of 3-butyl acrylate and its combination with the ingredient included at least The photoresist ingredient which is characterized by the absorbance of said photoresist film in 365nm being in the range per [2-6] micrometer and which carries out acid-resisting ******.
[Claim 24] The photoresist ingredient with which molar extinction coefficient epsilon in the above-mentioned 365nm is characterized by copolymerizing the 4th monomer by which the above-mentioned high molecular compound is chosen instead of the extinction agent more than 8,000 (l/cm-mol) from the group which molar extinction coefficient epsilon in 365nm becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in addition to the above 1st, 2nd, or 3rd monomer in a photoresist ingredient according to claim 23 and which carries out acid-resisting ******.
[Claim 25] The photoresist ingredient which is characterized by being the copolymer of the 4th monomer with which it is chosen out of the group which molar extinction coefficient epsilon [in / in the above-mentioned high molecular compound / the 1st, 2nd, or 3rd monomer of the above and 365nm] becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in a photoresist ingredient according to claim 23 and which carries out acid-resisting ******.
[Claim 26] The compound which generates an acid by exposure, and molar extinction coefficient epsilon in 248nm The extinction agent more than 8,000 (l./cm and mol), and the 1st monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination at least, The 2nd monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination, the [or / tertiary butyl methacrylate and] -- the high molecular compound which is the copolymer of a monomer chosen from the group which consists of 3-butyl acrylate and its combination with the ingredient included at least The photoresist ingredient which is characterized by the absorbance of said photoresist film in 365nm being in the range per [2-6] micrometer and which carries out acid-resisting ******.
[Claim 27] The photoresist ingredient with which molar extinction coefficient epsilon in the above-mentioned 248nm is characterized by copolymerizing the 4th monomer by which the above-mentioned high molecular compound is chosen instead of the extinction agent more than 8,000 (l/cm-mol) from the group which molar extinction coefficient epsilon in 248nm becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in addition to the above 1st, 2nd, or 3rd monomer in a photoresist ingredient according to claim 26 and which carries out acid-resisting ******.
[Claim 28] The photoresist ingredient which is characterized by being the copolymer of the 4th monomer with which it is chosen out of the group which molar extinction coefficient epsilon [in / in the ~~above-mentioned high molecular compound / the 1st, 2nd, or 3rd monomer of the above and 248nm]~~ becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in a photoresist ingredient according to claim 26 and which carries out acid-resisting ******.

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Drawing selection Representative drawing

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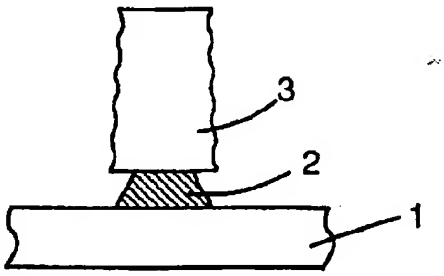

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the pattern formation approach of using the lithography technique at the time of manufacture of a semiconductor device, a magnetic-bubble device, an optical disk, liquid crystal, etc., and the photoresist used for it. It is related with the pattern formation approach for reducing fluctuation of the dimension of the pattern which originates especially in the reflected light from a substrate.
[0002]
[Description of the Prior Art] In manufacture of a semiconductor device etc., after forming the photoresist film on substrates, such as a silicon wafer, and carrying out pattern exposure, a development is performed and the photolithography technique of making the pattern of a resist forming on a substrate is used.
[0003] Fluctuation of the resist pattern dimension by the standing wave effectiveness and halation (scattered reflection from a substrate level difference) which originate in reflection of the substrate front face of pattern exposure light in this photolithography, and pattern deformation pose a big problem.
[0004] As law which reduces the standing wave effectiveness and halation, the approach using the light absorption layer (acid-resisting layer) which does not have photosensitivity in the lower layer of the photoresist film is learned (JP,59-93448,A, JP,60-227254,A).
[0005] By this approach, since an acid-resisting layer does not have photosensitivity, the upper photoresist film is exposed and developed and the antireflection film of a lower layer [wet or dry etching] is removed after forming a pattern.
[0006] as other approaches -- a portable conformer bull mask (PCM) -- the multilayer-resist process called law is known. (For example, JP,60-203941,A) . This uses for the upper layer the positive resist which consists of a novolak resin-quinone diazide compound, using the poly methyl isopropenyl ketone (PMIPK) containing an extinction agent etc. as a lower layer resist.
[0007] In this approach, a latent image is first formed in the upper resist by the 1st exposure light, and a pattern is formed on a lower layer resist by development. In the case of pattern exposure, a lower layer resist functions as an antireflection film, and reduces interferential action and scattered reflection. Next, a latent image is formed in a lower layer resist by the complete exposure by the 2nd exposure light by using as a mask the upper resist by which pattern formation was carried out, and negatives are developed with a different developer from the upper layer. Consequently, the pattern of the upper resist is imprinted by the lower layer resist.
[0008] Moreover, the approach of forming a pattern is indicated using a multilayer resist by which many matter with which the photoresist film of the lower layer section absorbs the wavelength of 350-500nm as compared with the resist film of a management is contained in JP,60-142515,A.
[0009]
[Problem(s) to be Solved by the Invention] By the approach using an acid-resisting layer without photosensitivity which is looked at by JP,59-93448,A and JP,60-227254,A, since a process increases,

there is a fault that a throughput falls, when carrying out dry etching of the lower layer, and there is no anisotropy when carrying out wet etching, there is a fault that formation of a detailed pattern is difficult.
[0010] moreover, a portable conformer bull mask (PCM) which is looked at by JP,60-203941,A -- two exposure and two development are required for law, and it has the fault that a process is complicated.
[0011] Moreover, by the approach looked at by JP,60-142515,A, since absorption of the lower layer section is large, in the lower layer section, the reaching exposure light decreases and light exposure runs short. Therefore, when performing pattern formation by the positive resist, for skirt length of the resist near a substrate front face, the lower layer section does not become a dimension as a mask, but a dimension controllability worsens.
[0012] In case the purpose of this invention conquers the fault of the conventional technique and forms a detailed pattern with a photolithography technique, it is to offer the photoresist used for the pattern formation approach and it which reduce dimension fluctuation of the pattern used as a technical problem which happens from the standing wave effectiveness and halation by the reflected light from a substrate, and deformation of a pattern.
[0013]
[Means for Solving the Problem] The above-mentioned purpose by heat-treatment after the process which forms the 1st photoresist film on a substrate, the process which forms the 2nd photoresist film on the 1st photoresist film, pattern exposure or pattern exposure, and exposure In the pattern formation approach including the process which forms a latent image in the 1st and 2nd photoresist film, and the process which develops the 1st and 2nd photoresist film with the same developer after latent-image formation The absorbance in the exposure wavelength of the 1st photoresist is larger than the absorbance of the 2nd photoresist film, and can attain by the pattern formation approach characterized by the pattern dimension of the 1st photoresist after development becoming below the pattern dimension of the 2nd photoresist.
[0014] The 1st photoresist film is in the range per [2-6] micrometer as an absorbance in exposure wavelength here, and the 2nd photoresist film has a desirable thing in the range per [0.1-0.8] micrometer.
[0015] Since the effectiveness which prevents the reflected light from a substrate is not enough when the absorbance of the 1st photoresist film is smaller than per [2] micrometer, it is not suitable for the purpose of this invention. Conversely, when larger than 6, exposure light cannot arrive easily to a pars basilaris ossis occipitalis, and a pattern cannot be formed. Therefore, the range of 2 to 6 has a desirable absorbance per micrometer, and the range of 3 to 5 is especially desirable. Moreover, when the absorbance of the 2nd photoresist film exceeds per [0.8] micrometer, since a good exposure profile is not obtained, it is not suitable for the purpose of this invention.
[0016] As for the pattern dimension of the 1st photoresist after development, it is desirable to become below the pattern dimension of the 2nd photoresist on it. Since an absorbance functions as an antireflection film greatly, the 1st photoresist has the bad profile of the exposure light of a there. Therefore, the pattern obtained cannot become a rectangle easily and the dimension controllability of the part is bad. On the other hand, the 2nd photoresist has downward the 1st photoresist which is the antireflection film, and the absorbance of itself is small, and the exposure profile of a there is good and does not have the effect of reflective. Consequently, the dimension controllability of the pattern obtained is also good at a rectangle. A dimension controllability uses the 1st bad photoresist as a mask in the case of the dry etching which processes the substrate with which it will continue after that here if the dimension of the 1st photoresist is larger than the dimension of the 2nd photoresist, etching is performed, and the dimension controllability of the part into which the substrate was processed worsens.

[0017] The thing smaller than the thickness of the 2nd photoresist film of the thickness of the 1st photoresist film is desirable. Moreover, the thickness of this 1st photoresist film has the desirable range of 0.05 to 0.5 micrometers, and 0.1 to its 0.3 micrometers are especially desirable. When the thickness of this 1st photoresist film is too large, for that absorption, exposure light cannot arrive easily to a pars basilaris ossis occipitalis, and pattern formation cannot be performed.

[0018] In order to make the pattern dimension of the 1st photoresist after development below into the pattern dimension of the part of the 2nd photoresist on it as mentioned above, in the case of a positive type, the sensibility of the 1st photoresist needs to be higher than the sensibility of the 2nd photoresist. When the sensibility of the 1st photoresist is lower than the sensibility of the 2nd photoresist, the 1st photoresist near a substrate will be hard to be exposed, and in a positive type, the pattern dimension of the 1st photoresist after development becomes larger than the pattern dimension of the 2nd photoresist, and it is not suitable for the purpose of this invention.

[0019] Moreover, conversely, it becomes superfluous, and a pattern falls or the exposure to the 1st photoresist becomes easy to separate, when the sensibility of the 1st photoresist is too high compared with the sensibility of the 2nd photoresist. Therefore, as for the sensibility of the 1st photoresist, what is the 20 times [1 to] as many range of the sensibility of the 2nd photoresist as this is desirable. The photoresist of the positive type which contains at least the alkali fusibility high molecular compound which has a ring, and a quinone diazide compound as an example of the 1st and 2nd photoresists used by the pattern formation approach of this invention can be mentioned.

[0020] As an alkali fusibility high molecular compound which has a ring here, novolak resin, halogenation novolak resin, a polyvinyl phenol, acetone-pyrogallol resin, a styrene maleic anhydride copolymer, etc. are mentioned. Moreover, as a quinone diazide compound, 1 of polyhydroxy compounds, such as 2, 3, and 4-trihydroxy benzophenone, and an ester compound with 2-naphthoquinonediazide-5-(and/or, -4-) sulfonyl chloride are mentioned. These quinone diazide compounds are independent, or can be used in two or more sorts of combination.

[0021] Moreover, as the 1st and 2nd photoresists used by this invention, the photoresist of the positive type with which alkali fusibility increases can be mentioned by heat-treatment after pattern exposure or pattern exposure, and exposure, including at least the compound which generates an acid by the exposure of an activity radiation, and the high molecular compound which has a ring.

[0022] The compound which generates an acid by exposure of onium salts, sulfonates, and the nitrobenzyl ester of a sulfonic acid as an example of such an ingredient, The hydroxyl group of the phenol resin of alkali fusibility A t-butoxycarbonyl group, The ingredient which contains at least what was protected by the TETOHIDORO pyranyl radical etc., The ingredient which contains at least the compound which protected the alkali fusibility radical of the low molecular weight compound of the compound which generates an acid by the above-mentioned exposure, the phenol resin of alkali fusibility, and alkali fusibility, or a high molecular compound by the t-butoxycarbonyl group, the TETOHIDORO pyranyl radical, etc. is mentioned. It is easy to adjust sensibility by changing the amount of the compound which generates an acid by exposure with such an ingredient.

[0023] The 1st photoresist used for the pattern formation approach of this invention can add the following extinction agents to the above photoresists, and can raise the absorbance in exposure wavelength.

[0024] As an extinction agent, ingredients, such as a triazole system, monoazo, a coumarin system, a pyrazolone system, an imidazoline system, an azomethine system, a stilbene system, an acenaphthene system, a benzophenone system, a chalcone system, an anthracene system, and a benzylidene indene system, are mentioned.

[0025] In addition, as an extinction agent, it is not limited to these, molar extinction coefficient epsilon in exposure wavelength is a thing more than 8,000 (l/cm-mol), and does not sublimate at the time of heat treatment of prebaking of a photoresist etc., but it can be used if it does not have a bad influence on the sensitization property of a photoresist, and a dissolution property.

[0026] These extinction agents may be used independently, and two or more sorts can be mixed and they can also be used. Moreover, covalent bond of these extinction agents can be carried out to the high molecular compound contained in the 1st photoresist, and they can also be used for it. Furthermore, these extinction agents are the range which fulfills the conditions of an above-mentioned absorbance, and may be contained in the 2nd photoresist.

[0027] In the pattern formation approach of this invention, when a developer is an alkali water solution, the extinction agent which has a phenolic hydroxyl group may be used as an above-mentioned extinction

agent. Such an extinction agent accelerates the dissolution rate of a photoresist by addition to a photoresist. Therefore, in the case of the photoresist of a positive type, appearance high sensitivity is formed.

[0028] The 1st photoresist used by the pattern formation approach of this invention and the 2nd photoresist may be completely different ingredients.

[0029] For example, as the 1st photoresist, poly dimethyl glutar imide and the ingredient which contains a quinone diazide compound at least may be used. The solubility over a resist solvent differs from the high molecular compound with which poly dimethyl glutar imide has a phenolic hydroxyl group here. Therefore, when the high molecular compound which has a phenolic hydroxyl group is used as the 2nd photoresist, it is easier to form the film in a bilayer.

[0030] As a quinone diazide compound here, 1 of polyhydroxy compounds, such as 2, 3, and 4-trihydroxy benzophenone, and an ester compound with 2-naphthoquinonediazide-5-(and/or, -4-) sulfonyl chloride are mentioned. These quinone diazide compounds are independent, or can be used in two or more sorts of combination.

[0031] As for this poly dimethyl glutar imide and the ingredient which contains a quinone diazide compound at least, it is desirable to add the extinction agent which has absorption in exposure wavelength. The ingredient mentioned above is mentioned as an extinction agent used here.

[0032] In addition, as an extinction agent, it is not limited to these, has absorption strong against exposure wavelength, and does not sublimate at the time of heat treatment of prebaking of a photoresist etc., but it can be used if it does not have a bad influence on the sensitization property of a photoresist, and a dissolution property.

[0033] Moreover, as a constituent of the 1st photoresist, the high molecular compound which is the copolymer of the following monomers at least may be used.

[0034] 1) The monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination.

[0035] 2) The monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination.

[0036] The solubility over a resist solvent differs from the high molecular compound with which an above-mentioned high molecular compound also has a phenolic hydroxyl group. Therefore, when the high molecular compound which has a phenolic hydroxyl group is used as the 2nd photoresist, it is easier to form the film in a bilayer. Also in this case, the above quinone diazide compounds can be used as a sensitization agent. Moreover, it is desirable to add the extinction agent which has absorption in exposure wavelength which was mentioned above.

[0037] Furthermore, the above-mentioned high molecular compound may carry out the copolymer of the monomer chosen from the group which molar extinction coefficient epsilon in exposure wavelength becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in addition to above monomer 12. Molar extinction coefficient epsilon in exposure wavelength can compound the methacrylic ester and acrylic ester more than 8,000 (l/cm-mol) by esterifying the extinction agent which has absorption in the above exposure wavelength. In such a copolymer, since the extinction agent has become some high molecular compounds, when the film is formed in a bilayer, it is hard to mix an extinction agent in the upper layer.

[0038] Furthermore, said high molecular compound may be the copolymer of the following monomer at least, including at least the compound and high molecular compound with which the 1st photoresist generates an acid in exposure by the activity radiation.

[0039] 1) The monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination.

[0040] 2) The monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination.

[0041] 3) the [tertiary butyl methacrylate and] -- the monomer chosen from the group which consists of 3-butyl acrylate and its combination.

[0042] As a compound which generates an acid by exposure here, onium salts, sulfonates, and the

nitrobenzyl ester of a sulfonic acid are mentioned.
[0043] the acid generated in the exposure section by heat-treatment after exposure and exposure in the above-mentioned photoresist -- the [tertiary butyl methacrylate or] -- since the tertiary butyl of 3-butyl acrylate ****s and a methacrylic acid or an acrylic acid is made, the alkali solubility of the part there serves as a positive type in increase and alkali development.
[0044] It is desirable to add the extinction agent which has absorption in exposure wavelength which was mentioned above also in this case. Furthermore, the above-mentioned high molecular compound may carry out the copolymer of the monomer chosen from the group which molar extinction coefficient epsilon in exposure wavelength becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in addition to above monomer 123. Molar extinction coefficient epsilon in exposure wavelength can compound the methacrylic ester and acrylic ester more than 8,000 (l/cm-mol) by esterifying the extinction agent which has absorption in the above exposure wavelength. In such a copolymer, since the extinction agent has become some high molecular compounds, when the film is formed in a bilayer, it is hard to mix an extinction agent in the upper layer.
[0045] In the pattern formation approach of this invention, when using copolymers, such as the above poly dimethyl glutar imide or methacrylic ester, and acrylic ester, as a giant-molecule component of the 1st photoresist, as the 2nd photoresist, it has photosensitivity in ultraviolet radiation, far-ultraviolet light, vacuum-ultraviolet light, etc. including the high molecular compound which has a phenolic hydroxyl group, and the ingredient of the arbitration which can form a pattern according to a development process is mentioned.
[0046] In case the 2nd photoresist imprints a pattern to the substrate after the resist pattern was formed, it is desirable to have sufficient dry cleaning dirty resistance at least here. Then, when using ultraviolet radiation and far-ultraviolet light as an exposure light, it is desirable to include the high molecular compound which has a ring.
[0047] Moreover, the photoresist ingredient used for the pattern formation approach of this invention is also set as the object of this invention.
[0048] As a photoresist ingredient of this invention, poly dimethyl glutar imide, a quinone diazide compound, and molar extinction coefficient epsilon in 365nm are the ingredients which contain the extinction agent more than 8,000 (l/cm-mol) at least, and the photoresist ingredient which is characterized by the absorbance of the paint film of said ingredient in 365nm being in the range per [2-6] micrometer and which carries out acid-resisting ****** is mentioned.
[0049] Moreover, the photoresist ingredient which is characterized by the absorbance of the paint film of said ingredient in 365nm being in the range per [2-6] micrometer with the ingredient with which a quinone diazide compound and molar extinction coefficient epsilon in 365nm contain at least the extinction agent more than 8,000 (l/cm-mol) and the high molecular compound which is the copolymer of the following monomer at least and which carries out acid-resisting ****** is also mentioned.
[0050] 1) The monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination.
[0051] 2) The monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination.
[0052] The solubility over a resist solvent differs from the high molecular compound with which the high molecular compound above-mentioned [these] has a phenolic hydroxyl group. Therefore, on these ingredients, it is easy to form the photoresist film using the high molecular compound which has a phenolic hydroxyl group in a bilayer.
[0053] As a quinone diazide compound used here, 1 of polyhydroxy compounds, such as 2, 3, and 4-trihydroxy benzophenone, and an ester compound with 2-naphthoquinonediazide-5-(and/or, -4-) sulfonyl chloride are mentioned. These quinone diazide compounds are independent, or can be used in two or more sorts of combination.
[0054] As an extinction agent more than 8,000 (l/cm-mol), ingredients, such as a coumarin system, a stilbene system, a chalcone system, an anthracene system, and a benzylidene indene system, are mentioned for molar extinction coefficient epsilon in 365 morenm. What does not sublimate at the time

of heat treatment of prebaking of a photoresist etc., and does not have a bad influence on the sensitization property of a photoresist and a dissolution property in this is desirable. These extinction agent may be used independently, and two or more sorts can be mixed and it can also be used.
[0055] Instead of furthermore adding an extinction agent, the above-mentioned high molecular compound may carry out the copolymer of the monomer chosen from the group which molar extinction coefficient epsilon in 3365nm becomes from the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination in addition to above monomer 12. In such a copolymer, since the extinction agent has become some high molecular compounds, when the film is formed in a bilayer, it is hard to mix an extinction agent in the upper layer.
[0056] Moreover, to the high molecular compound which copolymerized the above extinction agents, an extinction agent may be added further.
[0057] Moreover, the photoresist ingredient with which the absorbance of said photoresist film in 365nm is characterized by being in the range per [2-6] micrometer and which carries out acid-resisting ****** can also be set as the object of this invention by the compound which generates an acid by exposure, and molar extinction coefficient epsilon in 365nm with the extinction agent more than 8,000 (l/cm-mol), and the ingredient which contains at least the high molecular compound it is [high molecular compound] the copolymer of following monomer 123 at least.
[0058] 1) The monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination.
[0059] 2) The monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination.
[0060] 3) the [tertiary butyl methacrylate and] -- the monomer chosen from the group which consists of 3-butyl acrylate and its combination.
[0061] As a compound which generates an acid by exposure here, onium salts, sulfonates, and the nitrobenzyl ester of a sulfonic acid are mentioned. These acid generators may be used with the sensitizer which carries out sensitization of it if needed. the acid which is heat-treatment after exposure and exposure as an extinction agent in the above-mentioned photoresist which can use the above mentioned, and was generated in the exposure section -- the [tertiary butyl methacrylate or] -- since the tertiary butyl of 3-butyl acrylate ****s and a methacrylic acid or an acrylic acid is made, the alkali solubility of the part there serves as a positive type in increase and alkali development.
[0062] Instead of furthermore adding an extinction agent also in this case, molar extinction coefficient epsilon [in / in addition to above monomer 123 / in the above-mentioned high molecular compound / 4365nm] may carry out the copolymer of the monomer chosen from the group which consists of the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination. In such a copolymer, since the extinction agent has become some high molecular compounds, when the film is formed in a bilayer, it is hard to mix an extinction agent in the upper layer.
[0063] Moreover, to the high molecular compound which copolymerized the above extinction agents, an extinction agent may be added further.
[0064] Moreover, the photoresist ingredient with which the absorbance of said photoresist film in 248nm is characterized by being in the range per [2-6] micrometer and which carries out acid-resisting ****** can also be set as the object of this invention with the ingredient with which the compound which generates an acid by exposure, and molar extinction coefficient epsilon in 248nm contain at least the extinction agent more than 8,000 (l/cm-mol), and the high molecular compound which is the following copolymer of monomer 123 at least. 1) The monomer chosen from the group which consists of alkyl methacrylate, alkyl acrylate, and its combination.
[0065] 2) The monomer chosen from the group which consists of the carboxylic acid of a methacrylate system, a carboxylic acid of an acrylate system, and its combination.
[0066] 3) the [tertiary butyl methacrylate and] -- as the monomer chosen from the group which consists of 3-butyl acrylate and its combination, and a compound which generates an acid by exposure here, onium salts, sulfonates, and the nitrobenzyl ester of a sulfonic acid are mentioned. These acid generators may be used with the sensitizer which carries out sensitization of it if needed. Although ingredients,

such as an anthracene system and a benzophenone system, are mentioned, if it does not sublimate at the time of heat treatment of prebaking of a photoresist etc. and does not have a bad influence on the sensitization property of a photoresist, and a dissolution property as an extinction agent, it will not restrict to these. These extinction agent may be used independently, and two or more sorts can be mixed and it can also be used. Instead of adding an extinction agent to the pan which can use the above mentioned also in this case, molar extinction coefficient epsilon [in / in addition to above monomer 123 / in the above-mentioned high molecular compound / 4248nm] may carry out the copolymer of the monomer chosen from the group which consists of the methacrylic ester more than 8,000 (l/cm-mol), acrylic ester, and its combination. In such a copolymer, since the extinction agent has become some high molecular compounds, when the film is formed in a bilayer, it is hard to mix an extinction agent in the upper layer.

[0067] Moreover, to the high molecular compound which copolymerized the above extinction agents, an extinction agent may be added further.

[0068]

[Function] In case a lithography technique performs pattern formation, the light which carried out incidence to the resist film reflects by the substrate interface, and the fall of the pattern dimensional accuracy of a resist and deformation of a pattern break out owing to the reflected light.

[0069] In the pattern formation approach of this invention, the absorbance in exposure wavelength uses the larger photoresist film for a lower layer, the photoresist film with a more small absorbance is used for the upper layer, and the upper lower layer performs pattern formation in one exposure and development. In order that a lower layer ingredient may work as an antireflection film which prevents the reflected light from a substrate, the upper layer is processed with dimensional accuracy sufficient moreover to a rectangle by pattern exposure. On the other hand, in a lower layer, light exposure runs short for the absorption, a pattern configuration serves as a trapezoid, and resolution and a dimension controllability fall. The light exposure of the lower layer section is insufficient, and it becomes impossible to positive-ize in the case of a positive resist. Thus, in the case of the dry etching which it will follow after that if the dimension of a lower layer part is larger than the dimension of the part of the upper layer, a dimension controllability uses a lower layer bad part as a mask, and etching is performed. Consequently, the dimension controllability of the processed substrate worsens.

[0070] In this invention, although an absorbance is large in a lower layer, the high sensitivity photoresist film is used for it. Therefore, although the configuration of the lower layer section is a trapezoid, the dimension of the lower layer section turns into below the pattern dimension of the part of the upper layer. Therefore, it will be etched with the dimension of the upper layer formed with dimensional accuracy sufficient to a rectangle in the case of the dry etching of a substrate. Consequently, the reflection from a substrate can be prevented and a pattern is formed with sufficient dimensional accuracy.

[0071]

[Example] The synthetic example of the ingredient used by this invention in advance of the example is described.

[0072] <Synthetic example 1> The methacrylic-acid chloride 5.7g tetrahydrofuran (30ml) was dropped there, having put in 9-anthracene methanol 8.4g, triethylamine 6.3g, and tetrahydrofuran 60ml the bottom of the synthetic desiccation nitrogen air current of 9-anthryl methyl methacrylate, and into 200ml flask, and ice-cooling. It agitated after dropping termination for about 1 hour, ice-cooled, and agitated at the room temperature after that for several hours.

[0073] Next, diethylether about 200ml was added here and the hydrochloride of the triethylamine which is the by-product of a reaction was carried out the ** exception. The hydrochloric-acid water solution washed the filtrate and, subsequently to washing and the last, the sodium-hydrogencarbonate water solution washed with water. This was dried by sulfuric-acid MAGUNESHIMU, reduced pressure distilling off of the solvent was carried out after that, and 9-anthryl methyl methacrylate 10g of yellow was obtained. Structure was checked with 1 H-NMR spectrum.

[0074] When the molar extinction coefficient of this 9-anthryl methyl methacrylate was measured in

ethanol, in 248nm, it was epsilon= 9,000 (l/cm-mol) at epsilon = 95,000 (l/cm-mol) or 365nm.
[0075] Here, although the synthetic example of 9-anthryl methyl methacrylate was described, if the extinction agent which has a phenolic hydroxyl group or an alcoholic hydroxyl group instead of 9-anthracene methanol as a composite raw material is used, the methacrylic ester which has an extinction part is compoundable. Moreover, if acrylic-acid chloride is used instead of methacrylic-acid chloride here, the acrylic ester which has an extinction part is compoundable. <Synthetic example 2> Tertiary butyl methacrylate 3.0g refined by vacuum distillation as a monomer, methyl methacrylate 1.5g, and 1.5g of methacrylic acids were put into the synthetic 200ml three-lot flask of a methacrylic ester copolymer, 9-anthryl methyl methacrylate 9.0g further compounded according to the synthetic example 1 was added, and azobisisobutyronitril 1.2g which recrystallized in tetrahydrofuran 50ml as a solvent, and was recrystallized with the methanol as a polymerization initiator was added. The polymerization was performed for 8 hours, carrying out the heating reflux of this at about 70 degrees C under a nitrogen air current. Tetrahydrofuran 100ml was added after the polymerization and it reprecipitated by dropping the solution at n-hexane about 700ml. The polymer which precipitated was dried the ** exception and 13.5g of methacrylic ester copolymers was obtained.
[0076] When the structure of the obtained polymer was checked by 1 H-NMR spectrum, it turned out that it is 10% [of methacrylic acids], and 9-anthryl methyl methacrylate 60% methyl methacrylate 10% tertiary butyl methacrylate 20% which is the monomer presentation (mole ratio) of preparation mostly.
[0077] The example shown below explains this invention.
[0078] On the silicon wafer which has the pattern of SiO2 with a <example 1> height of 0.3 micrometers, vacuum deposition of about 0.3-micrometer aluminum was carried out, and it considered as the substrate. Tertiary butyl methacrylate 20% compounded in the synthetic example 2 on this substrate, The copolymer 100 weight section which consists of 10% [of methacrylic acids], and 9-anthryl methyl methacrylate 60% methyl methacrylate 10%, 1, 4-JI (4-hydroxy benzal) acetophenone (by 365nm) which carried out private composition as the diphenyliodonium triflate 2 weight section and an extinction agent [epsilon=] (l/cm-mol) The 1st photoresist film (0.20 micrometers of thickness) which consists of the 30 weight sections is formed. The 2nd photoresist film (0.8 micrometers of thickness) which consists of the m, p-cresol novolak resin 100 weight section, 2 and 3, 1 of 4-trihydroxy benzophenone, and 2-naphthoquinonediazide-5-sulfonate 25 weight section on it was formed.
[0079] The absorbance in 365nm of the 1st photoresist film formed in the lower layer was 0.60 in 0.20 micrometers of thickness, and was 3.0 in 1 micrometer of thickness. On the other hand, the absorbance of the 2nd photoresist film used for the upper layer was 0.38 in 0.8 micrometers of thickness, and was 0.48 in 1 micrometer of thickness.
[0080] Subsequently, 500W The Xe-Hg lamp (USHIO make) and the 365nm band pass filter (product made from Schott) performed contact exposure using the mask. BEKU after exposure was performed for 2 minutes at 100 degrees C after exposure. Development was a 2.38 % of the weight water solution (NMD-3, TOKYO OHKA KOGYO make) of tetramethylammonium hydroxide, and after carrying out for 60 seconds at 23 degrees C, it performed the rinse for 30 seconds with pure water.
[0081] Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. When the cross section of the 1.0-micrometer Rhine pattern was observed with the scanning electron microscope, as it was drawing 1 , the standing wave of a management was small. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.
[0082] In addition, when the above-mentioned process conditions compared separately the sensibility of the 1st photoresist film and the 2nd photoresist film, the 1st photoresist film was [50 mJ/cm2] 2nd photoresist film 70 mJ/cm2, and the direction of the 1st photoresist film of the light exposure from which the residual film thickness after development is set to 0 was high sensitivity.
[0083] Instead of the 1st photoresist film used in the <example 2> example 1 Tertiary butyl methacrylate 10% compounded like the synthetic example 2, The copolymer 100 weight section which

consists of methyl methacrylate 80% and 10% of methacrylic acids, the diphenyliodonium triflate 5 weight section, the 4-hydroxy benzylidene indene which carried out private composition as an extinction agent (by 365nm) [epsilon=] l./cm and the (mol) 30 weight section, and the photoresist film (0.25 micrometers of thickness) that consists of the 9-anthracene methanol 3 weight section as a sensitizer are used. Instead of the 2nd photoresist, m, the p-cresol novolak resin 100 weight section, 4b, 5, 9b, 10-tetrahydro - the photoresist film (0.70 micrometers of thickness) which consists of the 2, 3, 7, 1 of -5 and 8-tetra-hydroxy 10-dimethyl indeno [2 and 1-a] indene, and 2-naphthoquinonediazide-5-sulfonic-acid tetra-ester 30 weight section It used and the same experiment as an example 1 was conducted.

[0084] The absorbance in 365nm of the photoresist film formed in the lower layer was 0.58 in 0.25 micrometers of thickness, and was 2.3 in 1 micrometer of thickness. On the other hand, the absorbance of the photoresist film used for the upper layer was 0.39 in 0.7 micrometers of thickness, and was 0.55 in 1 micrometer of thickness.

[0085] Subsequently, after [exposure and exposure] BEKU and development were performed like the example 1. Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. When the cross section of the 1.0-micrometer Rhine pattern was observed with the scanning electron microscope, as it was drawing 1 like the example 1, the standing wave of a management was small. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.

[0086] In addition, when the above-mentioned process conditions compared separately the sensibility of the 1st photoresist film and the 2nd photoresist film, the 1st photoresist film was [30 mJ/cm2] 2nd photoresist film 60 mJ/cm2, and the direction of the 1st photoresist film of the light exposure from which the residual film thickness after development is set to 0 was high sensitivity.

[0087] Instead of the 1st photoresist film used in the <example 3> example 1 Tertiary butyl methacrylate 20% compounded like the synthetic example 2, The copolymer 100 weight section which consists of 10% [of methacrylic acids], and 9-anthryl methyl methacrylate 25% methyl methacrylate 45%, The photoresist film (0.26 micrometers of thickness) which consists of the diphenyliodonium triflate 5 weight section is used. Instead of the 2nd photoresist, the 30% tetrahydropyranyl-ized Pori (p-vinyl phenol) 100 weight section, The same experiment as an example 1 was conducted using the photoresist film (0.70 micrometers of thickness) which consists of the screw (t-buthylphenyl) iodonium TORIFURORO methansulfonic acid salt 3 weight section.

[0088] The absorbance in 248nm of the photoresist film formed in the lower layer was 1.5 in 0.26 micrometers of thickness, and was 5.8 in 1 micrometer of thickness. On the other hand, the absorbance of the photoresist film used for the upper layer was 0.32 in 0.7 micrometers of thickness, and was 0.45 in 1 micrometer of thickness.

[0089] Subsequently, 500W The Xe-Hg lamp (USHIO make) and the 250nm interference filter (Optical Coatings Japan make) performed contact exposure using the mask. 100 degree C of BEKU after exposure were performed after exposure for 2 minutes. Development was a 2.38 % of the weight water solution (3 NMD- Tokyo adaptation make) of tetramethylammonium hydroxide, and after carrying out for 120 seconds at 23 degrees C, it performed the rinse for 30 seconds with pure water.

[0090] Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. When the cross section of the 1.0-micrometer Rhine pattern was observed with the scanning electron microscope, as it was drawing 1 like the example 1, the standing wave of a management was small. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.

[0091] In addition, when the above-mentioned process conditions compared separately the sensibility of the 1st photoresist film and the 2nd photoresist film, the 1st photoresist film was [10 mJ/cm2] 2nd photoresist film 60 mJ/cm2, and the direction of the 1st photoresist film of the light exposure from

which the residual film thickness after development is set to 0 was high sensitivity.
[0092] Instead of the 1st photoresist film used in the <example 4> example 1 Tertiary butyl methacrylate 10% compounded like the synthetic example 2, The copolymer 100 weight section which consists of methyl methacrylate 80% and 10% of methacrylic acids, The photoresist film (0.26 micrometers of thickness) which consists of the diphenyliodonium triflate 5 weight section, extinction agents 1 and 8, and the 9-trihydroxy anthracene 10 weight section is used. Instead of the 2nd photoresist, the 30% tetrahydropyranyl-ized Pori (p-vinyl phenol) 100 weight section, The same experiment as an example 1 was conducted using the photoresist film (0.70 micrometers of thickness) which consists of the screw (t-buthylphenyl) iodonium TORIFURORO methansulfonic acid salt 1 weight section.
[0093] The absorbance in 248nm of the photoresist film formed in the lower layer was 0.65 in 0.26 micrometers of thickness, and was 2.5 in 1 micrometer of thickness. On the other hand, the absorbance of the photoresist film used for the upper layer was 0.32 in 0.7 micrometers of thickness, and was 0.45 in 1 micrometer of thickness.
[0094] Subsequently, 500W The Xe-Hg lamp (USHIO make) and the 250nm interference filter (Optical Coatings Japan make) performed contact exposure using the mask. 100 degree C of BEKU after exposure were performed after exposure for 2 minutes. Development was a 2.38 % of the weight water solution (3 NMD- Tokyo adaptation make) of tetramethylammonium hydroxide, and after carrying out for 120 seconds at 23 degrees C, it performed the rinse for 30 seconds with pure water.
[0095] Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. When the cross section of the 1.0-micrometer Rhine pattern was observed with the scanning electron microscope, as it was drawing 1 like the example 1, the standing wave of a management was small. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.
[0096] Instead of the 1st photoresist film used in the <example 5> example 1 Tertiary butyl methacrylate 42% compounded like the synthetic example 2, The copolymer 100 weight section which consists of methyl methacrylate 42% and 16% of methacrylic acids, 2, 4', 7-trihydroxy - 1 of a 2, 4, and 4-trimethyl flavan, the 2-naphthoquinonediazide-5-sulfonic-acid triester 30 weight section, The photoresist film (0.20 micrometers of thickness) which consists of the 4-hydroxy benzylidene indene 30 weight section which carried out private composition as an extinction agent is used. The film (0.70 micrometers of thickness) of OFPR800 (TOKYO OHKA KOGYO make) was used instead of the 2nd photoresist, and the same experiment as an example 1 was conducted.
[0097] The absorbance in 365nm of the photoresist of entering [which was formed in the lower layer] an extinction agent was 0.62 in 0.20 micrometers of thickness, and was 3.1 in 1 micrometer of thickness. On the other hand, the absorbance of OFPR800 used for the upper layer was 0.39 in 0.7 micrometers of thickness, and was 0.55 in 1 micrometer of thickness.
[0098] Subsequently, exposure and development were performed like the example 1. Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. When the cross section of the 1.0-micrometer Rhine pattern was observed with the scanning electron microscope, as it was drawing 1 like the example 1, the standing wave of a management was small. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.
[0099] Instead of the 1st photoresist film used in the <example 6> example 1 The copolymer 100 weight section which consists of tertiary butyl methacrylate 20%, 18% [of methacrylic acids], and 9-anthryl methyl methacrylate 62% compounded like the synthetic example 2, 6, 7, 6', and 7' - tetra-hydroxy - 3, 3, 3', and 3' - tetramethyl-1 and 1' -- 1 of out - SUPIRO in, and the 2-naphthoquinonediazide-5-sulfonic-acid tetra-ester 30 weight section -- The photoresist film (0.20 micrometers of thickness) which consists of the 4-hydroxy benzylidene indene 20 weight section which carried out private composition as an

extinction agent is used. The photoresist film (0.8 micrometers of thickness) which consists of the m, p-cresol novolak resin 100 weight section, 2 and 3, 1 of 4-trihydroxy benzophenone, and 2-naphthoquinonediazide-5-sulfonate 25 weight section instead of the 2nd photoresist film was formed.
[0100] The absorbance in 365nm of the 1st photoresist film formed in the lower layer was 0.72 in 0.20 micrometers of thickness, and was 3.6 in 1 micrometer of thickness. On the other hand, the absorbance of the 2nd photoresist film used for the upper layer was 0.38 in 0.8 micrometers of thickness, and was 0.48 in 1 micrometer of thickness.
[0101] Subsequently, exposure and development were performed like the example 1. Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. When the cross section of the 1.0-micrometer Rhine pattern was observed with the scanning electron microscope, as it was drawing 1 like the example 1, the standing wave of a management was small. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.
[0102] Instead of the 1st photoresist film used in the <example 7> example 1 1 of a poly dimethyl glutar imide 100 weight section, 2, 3 and 4, and 4'-tetra-hydroxy benzophenone, the 2-naphthoquinonediazide-5-sulfonic-acid tetra-ester 40 weight section, The photoresist film (0.20 micrometers of thickness) which consists of the 4-hydroxy benzylidene indene 30 weight section which carried out private composition as an extinction agent is used. The photoresist film (0.8 micrometers of thickness) which consists of the m, p-cresol novolak resin 100 weight section, 2 and 3, 1 of 4-trihydroxy benzophenone, and 2-naphthoquinonediazide-5-sulfonate 25 weight section instead of the 2nd photoresist film was formed.
[0103] The absorbance in 365nm of the 1st photoresist film formed in the lower layer was 0.60 in 0.20 micrometers of thickness, and was 3.0 in 1 micrometer of thickness. On the other hand, the absorbance of the 2nd photoresist film used for the upper layer was 0.38 in 0.8 micrometers of thickness, and was 0.48 in 1 micrometer of thickness.
[0104] Subsequently, exposure and development were performed like the example 1. Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. When the cross section of the 1.0-micrometer Rhine pattern was observed with the scanning electron microscope, as it was drawing 1 like the example 1, the standing wave of a management was small. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.
[0105] In addition, when the above-mentioned process conditions compared separately the sensibility of the 1st photoresist film and the 2nd photoresist film, the 1st photoresist film was [60 mJ/cm2] 2nd photoresist film 70 mJ/cm2, and the direction of the 1st photoresist film of the light exposure from which the residual film thickness after development is set to 0 was high sensitivity.
[0106] On the silicon wafer which has the pattern of SiO2 with a <example 8> height of 0.3 micrometers, vacuum deposition of about 0.3-micrometer aluminum was carried out, and it considered as the substrate. On this substrate, m, the p-cresol novolak resin 100 weight section, 4b, 5, 9b, 10-tetrahydro - 2, 3, 7, 1 of -5 and 8-tetra-hydroxy 10-dimethyl indeno [2 and 1-a] indene, the 2-naphthoquinonediazide-5-sulfonic-acid triester 25 weight section, The film (about 0.30 micrometers of thickness) of the admiration radiation constituent which consists of the 1 and 4-JI (4-hydroxy benzal) acetophenone 30 weight section which carried out private composition as an extinction agent is formed. On it m, the p-cresol novolak resin 100 weight section, 4b, 5, 9b, 10-tetrahydro - 2, 3, 7, 1 of -5 and 8-tetra-hydroxy 10-dimethyl indeno [2 and 1-a] indene, and the film (about 0.8 micrometers of thickness) of the admiration radiation constituent which consists of the 2-naphthoquinonediazide-5-sulfonate 25 weight section were formed.
[0107] The absorbance in 365nm of the admiration radiation constituent of entering [which was formed in the lower layer] an extinction agent was 0.66 in 0.3 micrometers of thickness, and was 2.2 in 1

micrometer of thickness. On the other hand, the absorbance of the admiration radiation constituent used for the upper layer was 0.40 in 0.8 micrometers of thickness, and was 0.50 in 1 micrometer of thickness.

[0108] Subsequently, 500W The Xe-Hg lamp (USHIO make) and the 365nm band pass filter (product made from Schott) performed contact exposure using the mask. Development was a 2.38 % of the weight water solution (NMD-3, TOKYO OHKA KOGYO make) of tetramethylammonium hydroxide, and after carrying out for 60 seconds at 23 degrees C, it performed the rinse for 30 seconds with pure water.
[0109] Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.
[0110] On the silicon wafer which has the pattern of SiO2 with a <example 9> height of 0.3 micrometers, vacuum deposition of about 0.3-micrometer aluminum was carried out, and it considered as the substrate. The resin 100 weight section which the hydroxyl group of Pori (p-vinyl phenol) of weight average molecular weight 6,500 tetrahydropyranyl-ized 30% on this substrate, The screw (t-buthylphenyl) iodonium TORIFURORO methansulfonic acid salt 3 weight section, The film (0.3 micrometers of thickness) of the admiration radiation constituent which consists of the 4-hydroxy benzophenone (epsilon= 13,000 [248nm] (l/cm-mol)) 30 weight section as an extinction agent is formed. The film (0.8 micrometers of thickness) of the admiration radiation constituent which becomes on it from the above-mentioned 30% tetrahydropyranyl-ized Pori (p-vinyl phenol) 100 weight section and the screw (t-buthylphenyl) iodonium TORIFURORO methansulfonic acid salt 3 weight section was formed.
[0111] Subsequently, 500W The Xe-Hg lamp (USHIO make) and the 250nm interference filter (Optical Coatings Japan make) performed contact exposure using the mask. 100 degree C of BEKU after exposure were performed after exposure for 2 minutes. Development was a 2.38 % of the weight water solution (3 NMD- Tokyo adaptation make) of tetramethylammonium hydroxide, and after carrying out for 120 seconds at 23 degrees C, it performed the rinse for 30 seconds with pure water.
[0112] The absorbance in 248nm of the admiration radiation constituent of entering [which was formed in the lower layer] an extinction agent was 0.63 in 0.3 micrometers of thickness, and was 2.1 in 1 micrometer of thickness. On the other hand, the absorbance of the admiration radiation constituent used for the upper layer was 0.40 in 0.8 micrometers of thickness, and was 0.50 in 1 micrometer of thickness.

[0113] Consequently, the above-mentioned resist film was developed by one development, and the pattern almost faithful to a mask pattern was formed. Moreover, when pattern dimension width of face was observed and measured with the scanning electron microscope in the location equivalent to the part of a crest, and the part of a trough also about the resist pattern which intersects the level difference part of a substrate substrate front face, the difference was small and the acid-resisting effectiveness was checked.
[0114]
[Effect of the Invention] According to this invention, in case a detailed pattern is formed with a lithography technique at the time of manufacture of a semiconductor device etc., it is possible to reduce dimension fluctuation of the pattern which happens by the interferential action and scattered reflection by the reflected light from a substrate. Since the pattern formation is still more possible in one exposure and development, compared with the conventional multilayer-resist method, a process is easy.

[Translation done.]